RESEARCH

Effectiveness of the Rural Trauma Team Development Course for Educating Nurses and Other Health Care Providers at Rural Community Hospitals

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ABSTRACT

The study evaluates (1) health care provider perception of the Rural Trauma Team Development Course (RTTDC); (2) improvement in acute trauma emergency care knowledge; and (3) early transfer of trauma patients from rural emergency departments (EDs) to a verified trauma center. A 1-day, 8-hour RTTDC was given to 101 nurses and other health care providers from nine rural community hospitals from 2011 to 2013. RTTDC participants completed questionnaires to address objectives (1) and (2). ED and trauma registry data were queried to achieve objective (3) for assessing reduction in ED time (EDT), from patient arrival to decision to transfer and ED length of stay (LOS). The RTTDC was positively perceived by health care providers (96.3% of them completed the program). Significant improvement in 13 of the 19 knowledge items was observed in nurses. Education intervention was an independent predictor in reducing EDT by 28 minutes and 95% confidence interval (CI) [−57, −0.1] at 6 months post-RTTDC, and 29 minutes and 95% CI [−53, −6] at 12 months post-RTTDC. Similar results were observed with ED LOS. The RTTDC is well-perceived as an education program. It improves acute trauma emergency care knowledge in rural health care providers. It promotes early transfer of severely injured patients to a higher level of care.

Key Words

ED LOS, Emergency department time, Knowledge improvement, RTTDC education, Rural emergency trauma care

The Ad Hoc Rural Trauma Committee of the American College of Surgeons Committee on Trauma (ACS-COT) developed the Rural Trauma Team Development Course (RTTDC). One reason for RTTDC development was to strengthen relationships between designated trauma centers and small community hospitals and rural physicians. Such relationships include collaborative continuing education and assistance in trauma performance improvement processes with the ultimate goal of decreasing preventable morbidity and mortality in rural America (ACS-COT 2004; 2006; 2010; 2014). RTTDC development began in 1998, and the first courses were conducted in 2003. The first RTTDC manual was released in 2004 (ACS-COT, 2004) (C. Lorenc, personal communication, March 18, 2015) and upgraded in 2006 (ACS-COT, 2006) and 2010 (ACS-COT, 2010).

There were 821 RTTDC training sessions provided by facilities and trauma centers in 37 U.S. states from 2003 to January 2015 (ACS, 2015). There were limited studies in published literature. A North Carolina trauma center study provided a brief description on knowledge improvement after the education by using pre- and posttest scores (Stafford et al., 2010). The other study, from West Virginia, examined the effect of the RTTDC education program on emergency department time (EDT) from patient arrival to time of decision to transfer trauma patients to a level 1 trauma center by using one-way analysis of variance (ANOVA) (Kappel, Rossi, Polack, Avtgis, & Martin, 2011). Perception studies on the RTTDC were not found in published literature.

RESEARCH QUESTIONS

1. Is the RTTDC perceived as a first-class education program by rural health care providers?
2. Using RTTDC education, is there significant knowledge improvement in nurses and other rural health care providers on initial assessment, resuscitation, and transfer of the traumatized patient to trauma centers?

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The authors declare no conflicts of interest.

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DOI:10.1097/JTN.0000000000000176

3. Does RTTDC education lead to a significant reduction in EDT or ED length of stay (LOS) at rural EDs before transfer to definitive care, within 6 and 12 months pre- and post-education?

METHODS

Study Design

The study design consisted of

1. a perception survey of health care providers,
2. a pre-/post-education survey of the providers, and
3. a pre-/post-education study design based on retrospectively collected data.

The study was approved as exempt by the Parkview Health Institutional Review Board.

Study Setting and Population

The study was done at the Parkview Adult and Pediatric Level 2 Trauma Center (PTC) in Fort Wayne, Indiana, which has been verified by the American College of Surgeons since 2000. The trauma center has four Parkview Community Hospitals (PCHs) in its trauma network. It provides trauma care in northeast Indiana, northwest Ohio, and southern Michigan.

The RTTDC training was held from November 2011 to February 2013. The study population comprised a total of 163 participants (101 nurses, eight physicians, 33 prehospital personnel, 13 respiratory therapists, and eight radiology technicians, after excluding one laboratory technician and five unknown participants) from nine rural community hospitals, which include the four PCHs. The nurses were all hospital employed, and in most cases the physicians were employed by an independent, private physician staffing company. Despite their relatively low participation rate, other health care providers were included in the study for comparison between the nurses and other categories of providers. The hospitals were from six counties in northeast Indiana and three counties in northwest Ohio. All the counties are situated in flat land areas with a network of asphalt and gravel county roads and asphalt highways for transportation. According to the 2010 U.S. census, the mean population per county was 35,276 (range: 19,614–47,536), and population density per square mile was 93.7 (range: 47.1–116.4) (U.S. Census Bureau, 2015).

Trauma registry data were queried for patients who were transferred out of the ED within 6 months before and after RTTDC education (6-month pre- and posteducation group), as well as 12 months before and after education (12-month pre- and posteducation group). There were 541 patients transported by ground ambulance or private car. Because of lack of information related to scene vital signs and transport times in private car transports, we included only patients transported by ground ambulance, which consisted of 257 trauma patients, 114 patients at the pre- and 143 patients at the posteducation group. The other reason to extend the pre- and posteducation groups up to the 12-month period was to improve sample size as Walker, Jensen, Leroux, McVey, and Carter (2013) had shown that knowledge after intense airway management training in paramedics remained significantly better 6 and 12 months after education.

RTTDC Training

Every participant was provided a free copy of the RTTDC manual third edition. The outline of the course is shown in Appendix 1. The course instructors consisted of the medical director of the Trauma Services Department or American Board of Emergency Medicine (ABEM)-certified emergency physician, the trauma program manager, the trauma outreach coordinator, and the community trauma program coordinator. They utilized the RTTDC PowerPoint presentation for lectures on clinical trauma care and communication strategies, as well as three team performance scenarios for 8 hours on a single day at every rural hospital. The scenarios included in the course reinforced the concept of trauma triage guidelines for expedient transfer of critically injured patients to a trauma center after primary assessment and necessary resuscitation.

Instruments and Data Analysis

The RTTDC third edition evaluation form was used for the perception study. It included 16 questions on a 5-point Likert scale to rate the program as a whole, the course content, format and visuals, knowledge application and search for additional information, and assessment on instructors. The first question is in a question format and the other 15 questions are in the form of statements. The Cronbach α coefficient was calculated for questions with the same Likert scale to assess internal consistency. In addition, the evaluation form contained open-ended questions, asking the participants to list a minimum of two improvements they would change in their practice as a result of what was learned at the education activity and to describe barriers anticipated when implementing the changes. The evaluation form included space for participants to write general comments. The form was completed by the participants at the end of each RTTDC session.

The RTTDC third edition 19-question pre- and postcourse survey questionnaire was supplemented with the addition of information on demographics, type of provider, duration of work at their current job, and trauma-related courses previously attended. The questionnaire was administered to the participants before and after

completion of education. The survey questionnaire is in the form of seven true/false and 12 multiple-choice statements. The survey questions were framed to reflect various components of the RTTDC under the topic as given in Appendix 1. The knowledge scores at pre- and postsurveys for each question were determined by the McNemar test, and the 95% confidence interval (CI) for the difference between the scores was computed by Newcombe's method (Newcombe, 1998). The mean knowledge score and its range for each corresponding survey were estimated from the 19 questions by each type of provider.

For the assessment of early transfer of cases to PTC for definitive care, trauma patients admitted to the four PCHs that were registered at PTC trauma registry were selected. Data included mode of transport and transport times from scene to PCHs, demographics, mechanism of injury, trauma team activation (TTA) status, vital signs, injury severity score (ISS), and ED LOS. As the trauma registry does not record data to estimate time of patient arrival to decision to transfer, one of our investigators collected these data for EDT estimation from the Allscripts™ ED 2011 software. The vital signs, penetrating injury status, and age were classified according to the national trauma triage protocol for analysis (Centers for Disease Control and Prevention [CDC], 2012). An ISS of more than 15 was used to represent severe anatomic injury. The percentage distribution, and mean and standard deviation (*SD*) of variables of interest by pre- and posteducation were estimated.

Multivariable linear regression analysis was used to assess whether posteducation compared with preeducation was an independent predictor in reducing EDT, as well as ED LOS at PCHs. As demonstrated by Lumley, Diehr, Emerson, and Chen (2002), the *t* test and linear regression could perform well with data that were far from normal distribution in sufficiently large samples (e.g., ≥100). For this reason, the EDT, ED LOS, and emergency medical service (EMS) time were not transformed into natural logarithm in the analysis. A backward elimination approach was used for model reduction and estimation of coefficients, with 95% CI for education and other covariates on EDT or ED LOS. We calculated the coefficient of determination (R^2) to indicate how much variation in the dependent variable was explained by the model and *F* test for statistical significance of R^2. For the model diagnosis, we checked the normality assumption and independence of the error term (regression standardized residual) with nonconstant variance (heteroscedasticity) and correlation among independent variables (multicollinearity). A p value of $< .05$ was used to evaluate statistical significance.

All statistical analyses were performed using SPSS v.22.0 statistical programing software (IBM Corp. Released 2013, IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY: IBM Corp).

RESULTS

Perception of the RTTDC Program

Demographics and Occupation

The overall mean age (*SD*) for all providers was 44.59 years (12.04), with nurses 43.15 years (11.91), physicians 55.00 years (7.56), prehospital personnel 47.58 years (10.94), radiology technicians 46.25 years (13.56), and respiratory therapists 43.46 years (9.87). Females formed the majority at 72.1%, with 88.1% of nurses, 92.3% of respiratory therapists, and 87.5% of radiology technicians. Males were predominant at 63.6% among prehospital personnel and 100% among physicians. The majority (61%) of the participants had over 10 years of work experience. Overall, 58% completed one or more trauma-related courses, such as trauma nursing core course (TNCC), advanced trauma care for nurses (ATCN), prehospital trauma life support (PHTLS), international trauma life transport (ITLS), and advanced trauma life support (ATLS). All physicians, 94% of prehospital personnel, 55% of nurses, 23% of respiratory therapists, and none of the radiology technicians had completed trauma-related courses.

Perception of Health Care Providers

Over 94% of the nurses and other providers cited strongly agree or agree to all 16 questions in the RTTDC evaluation questionnaire. Of the nurses, 66 to 90% provided excellent or strongly-agreed responses to those 16 questions (Table 1). The overall reliability coefficient for the set of 15 questions that have the same measurement scale was 0.938. The interitems were positively correlated, and their interitem correlation matrix values between the 15 questions were greater than 0.3. About 26% of the nurses, 50% of physicians and 22% of prehospital personnel felt that "better communication among team members and with trauma centers" should be the change in practice resulting from attending the program. Only the nonphysician providers, varying from 11 to 30%, agreed that "work as a team" should be the change in practice. Again, the nurses and prehospital personnel felt that "communication/education" was the possible barrier for the change, and physicians and respiratory therapists selected "lack of resources" as the barrier. Of the 48 individuals who provided the general comments, including 29 nurses from seven hospitals, the common responses addressed most were expressions of thanks for providing the course (54.1%), knowledge improvement gained from the course (18.8%), and knowledge and ability of instructors (10.4%).

Improvement of Knowledge

A few providers did not respond to each question on the pre- or posteducation surveys. Analysis was done on

TABLE 1 Evaluation on the RTTDC Program on Questions With "Excellent/Strongly Agree" Scale by Type of Providers

Question[a]	Nurse (n = 100)[b]	Prehospital Providers (n = 29)	Physician (n = 7)	Respiratory Therapist (n = 13)	Radiology Technician (n = 8)	Total (n = 157)
About the program						
Overall, how would you rate this activity?[c]	75.8	68.8	100	70.0	40.0	73.3
Program topics and content met the stated objectives	78.8	72.4	100	76.9	62.5	77.6
Program was fair, objective, and unbiased toward any product or program	81.8	89.7	85.7	63.6	75.0	81.8
Course content, format, and visuals						
Content was relevant to my educational need	80.0	72.4	100	76.9	37.5	77.1
Content is organized in a concise, logical sequence	76.0	75.9	100	76.9	75.0	77.1
Educational format was conducive to learning	82.0	75.9	100	76.9	75.0	80.9
Course format (lecture/team performance scenarios) stimulates critical thinking	80.0	86.2	100	76.9	75.0	82.1
Course manual is well-written, visually appealing and a good reference	69.7	57.1	100	76.9	75.0	69.5
Audiovisuals enhance the presentation	66.0	69.0	100	76.9	75.0	69.2
Knowledge application and search for additional information						
Acquired knowledge will be applied in my practice environment	82.7	79.3	100	84.6	37.5	80.6
I will seek additional information on this subject	71.7	57.1	100	69.2	50.0	69.0
Assessment on instructors						
Instructors knowledgeable about content	90.0	86.2	100	84.6	75.0	89.1
Instructors' presentation style keeps participant's attention	84.0	89.7	100	76.9	62.5	84.1
Instructors use examples to illustrate major points	86.0	86.2	100	84.6	62.5	85.4
Instructors present content accurately and confidently	87.5	86.2	100	84.6	75.0	87.5
Instructors answer questions in a supportive manner	89.0	96.6	100	76.9	75.0	89.2

Note. RTTDC = Rural Trauma Team Development Course.

[a]The 16 questions in the evaluation form are rearranged according to subheadings.

[b]Number of participants in parentheses.

[c]Rating scale of 5 to 1 is used: 5 = excellent; 4 = very good; 3 = good; 2 = fair; 1 = poor. For other 15 questions, rating scale of 5 to 1 with different wording is used: 5 = strongly agree; 4 = agree; 3 = good; 2 = fair; 1 = strongly disagree.

completed questions at both the pre- and postsurveys by each type of provider. Table 2 shows the differences in the mean knowledge score and knowledge improvement between nurses and other health care providers. Both the mean pre- and postsurvey knowledge scores in nurses were lower than those of physicians but higher than respiratory therapists and radiology technicians. The nurses achieved better knowledge improvement than all other providers, except radiology technicians. In addition, the nurses showed improvement in all 19 questions and 13 of which were statistically significant, whereas physicians showed the least improvement after the education (Table 2). The weighted mean response rate for each type of provider was determined on the basis of the number of question items, and the number of providers who attempted both the pre- and postsurveys. For instance, the item-provider response rate for 101 nurses was 98.6% [(1 × 90) + (1 × 97) + (1 × 98) + (2 × 99) + (5 × 100) + (9 × 101)/(19 × 101)] (Table 2).

Early Transfer of Trauma Cases to a Verified Trauma Center

Distribution of Variables Before and After RTTDC Education

The transport times at pre- and postsurveys were similar except in the 12-month education group, where the EMS and dispatch times were significantly different (Table 3). The distribution differences at pre- and posteducation by sex, TTA, triage criteria (age, trauma type, and vital signs) and ISS were similar in the two groups. There was only one case of penetrating injury (to head, neck, torso, and extremities proximal to elbow and knee) that met CDC triage criteria (CDC, 2012) in the 12-month pre- and posteducation groups and none in the 6-month education group. Abnormal respiratory rate, hypotension, penetrating injury, and ISS more than 15 accounted for less than 5% of patients.

Reduction in EDT and ED LOS

Univariate analysis demonstrated that at 6 months after the RTTDC, EDT was reduced by 21.7 minutes and ED LOS was reduced by 18.5 minutes. At 12 months after the RTTDC, EDT dropped by 21.6 minutes and ED LOS declined by 20.4 minutes. However, these reductions were not statistically significant (Table 4). After controlling for education, sex, age, TTA, EMS time, scene Glasgow Coma Scale, scene respiratory rate, scene systolic blood pressure, ISS, and trauma type, the education intervention (as an independent predictor) significantly reduced EDT by 28 minutes and 95% CI [−57, −0.1] at the 6-month, and 29 minutes and 95% CI [−53, −6] at the 12-month education groups. On the other hand, a near-significant (p = .065) reduction of 29 minutes and 95% CI [−60, +2], and significant (p = .004) reduction of 43 minutes and 95% CI [−72, −14] in ED LOS were found after the intervention at the two groups, respectively.

Time Delayed in Transferring Out at the ED

The delay time was measured from the time of decision to transfer to the time the patient was discharged from the ED at PCHs. The overall mean delay times in the ED after

TABLE 2 Mean Knowledge Score and Knowledge Improvement in Health Care Providers

Measure	Nurses (n = 101)[a]	Physicians (n = 8)[a]	Prehospital Personnel (n = 33)[a]	Respiratory Therapists (n = 13)[a]	Radiology Technicians (n = 8)[a]
Mean knowledge score (%)					
Presurvey (range)	56.9 (22.0–96.0)	68.2 (14.3–100)	60.5 (22.0–96.6)	48.7 (7.7–100)	42.1 (0–100)
Postsurvey (range)	82.5 (41.0-100)	90.0 (66.7-100)	79.9 (29.6-100)	73.2 (15.4-100)	73.2 (28.6-100)
Improvement (range)	25.5 (1.0–72.0)	21.8 (0–57.1)	19.4 (0–65.4)	24.5 (0–76.9)	31.1 (0–87.5)
Improvement by item					
Total items	19	19	19	19	19
Number of items improved (%)	19 (100)	12 (63.2)	18 (94.7)	16 (84.2)	16 (84.2)
Number of items significantly improved (%)	13 (68.4)	3 (15.8)	9 (47.4)	7 (36.8)	4 (21.1)
Item-provider response rate (%)	98.6	86.8	86.1	99.6	99.3

[a]*Original sample size is shown in parentheses.*

TABLE 3 Transport Times Among Transferred Trauma Patients at Four Parkview Community Hospitals

Time Measure (min)	6 Months					12 Months				
	Pre		Post			Pre		Post		
	n	*M* (*SD*)	*n*	*M* (*SD*)	*p*	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*p*
Field time	60	95.2 (38.7)	69	111.6 (91.5)	.666	101	85.6 (191.2)	134	94.1 (147.1)	.701
EMS time	67	45.0 (16.0)	73	48.4 (16.1)	.208	113	43.8 (15.3)	143	48.1 (15.2)	.026
Dispatch time	66	8.1 (5.0)	73	9.2 (6.1)	.232	112	7.6 (5.0)	143	9.5 (5.7)	.005
Scene time	66	19.6 (7.5)	73	18.9 (8.4)	.596	112	19.2 (7.8)	143	18.4 (7.5)	.418

Note. EMS = emergency medical service; M = mean; Pre = Pre-RTTDC education; Post = Post-RTTDC education; SD = standard deviation.

Statistical significance at $p < .05$.

time of decision to transfer to the PTC were similar between the pre- and postsurveys within the 6-month and 12-month education groups (Table 5).

DISCUSSION

About 96.3% (157 of the 163) of the health care providers completed the RTTDC program. The nurses formed the majority (101 of the 163) of the participants in our RTTDC education program, which was similar to the North Carolina study (Stafford et al., 2010). They also constituted more than 53% (29 of the 54) of health care providers who came from the four PCHs (four from hospital No. 48, 11 from No. 50, six from No. 58, and eight from No. 69), which were involved in the early transfer assessment study. The RTTDC program recommends a physician or physician extender as the team leader of a rural trauma team of at least three members. The nurses are the second and third team members. The third team member could also be a prehospital provider, technician, or other staff. Therefore, the nurses form an important component of the rural trauma team in each rural hospital.

Our study demonstrated via the perception survey that the RTTDC education program was highly rated by the rural trauma team members as over 94% of them strongly agreed or agreed on 16 questions related to the strength of the RTTDC program. In addition, the RTTDC third edition course evaluation questionnaire is highly reliable and appropriate for the evaluation as indicated by the Cronbach α and positive interitem correlation values. As in the North Carolina study (Stafford et al., 2010), some providers in our study reported constructive changes in communication among team members and with trauma centers resulting from attending the program. However, unlike that study, our providers did not cite lack of attendance of emergency physicians and surgeons as a barrier.

All participants benefited from attending the RTTDC education. In terms of improvement in knowledge score, nurses, radiology technicians, and respiratory therapists gained the most knowledge, followed by physicians and prehospital personnel, without regard to the number of providers participated. One reason may be due to lesser exposure to trauma-related training in the radiology technicians (0%), respiratory therapists (23.1%), and nurses (54.5%) than the prehospital providers (93.9%) and physicians (100%) before the RTTDC. The fact that improvement on all 19 questions occurred in nurses, 18 in prehospital personnel, 16 in respiratory therapists and radiology technicians, and 12 in physicians (Table 2),

TABLE 4 Univariate Analyses on Early Decision to Transfer Indicators for Trauma Patients at Four Parkview Community Hospitals

Time Measure (min)	6-Month Pre-/Post-RTTDC Education			12-Month Pre-/Post-RTTDC Education		
	Reduction/Increase	95% CI	*p*	Reduction/Increase	95% CI	*p*
EDT	−21.7	[−7.6, 51.0]	.145	−21.6	[−1.2, 44.5]	.064
ED LOS	−18.5	[−13.8, 50.8]	.260	−21.8	[−6.7, 50.3]	.133

Note. CI = confidence interval; EDT = emergency department time; ED LOS = emergency department length of stay.

Statistical significance at $p < .05$.

TABLE 5 Delay Time in Minutes at Four Parkview Community Hospitals

Hospital Random Number	6 Months					12 Months[a]				
	Pre		Post			Pre		Post		
	n	*M* (*SD*)	*n*	*M* (*SD*)	*p*	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*p*
48	19	24.26 (17.32)	15	19.00 (20.66)	.352	29	24.66 (19.04)	25	14.72 (18.99)	.061
50	15	47.80 (82.91)	16	72.38 (60.75)	.470	27	75.26 (133.50)	30	74.63 (54.79)	.981
58	16	33.75 (34.03)	26	29.62 (36.11)	.715	27	41.19 (43.06)	53	50.13 (63.62)	.513
69	11	32.36 (23.24)	15	21.60 (25.32)	.279	22	33.68 (37.43)	27	22.37 (32.08)	.260
Total	61	34.00 (46.38)	72	35.24 (43.21)	.874	105	43.81 (75.38)	135	43.47 (54.44)	.967

Note. M = mean; Pre = Pre-RTTDC education; Post = Post-RTTDC education; SD = standard deviation.

[a]7.9% (9/114) and 5.6% (8/143) of patients had no recorded date or time of decision to transfer at pre- and postsurveys, respectively.

Statistical significance at $p < .05$.

indicated that the content of the RTTDC third edition pre- and postcourse survey questionnaire is a useful instrument in testing sufficient knowledge improvement skill level by type of trauma team member. The observed improvement in knowledge among health care providers is probably attributable to the RTTDC education intervention. The item-provider response rate in each type of provider was high, over 86%. More important, knowledge improvement in nurses and other health care providers through the course could speed up the decision to transfer severely injured patients to a high level of trauma care.

Our study is also an educational intervention study on EDT and ED LOS. Vital signs and EMS time are important covariates in controlling for assessment of post-education on these outcomes. EMS time was preferred to field time for controlling transport time. The field time had more missing values than EMS time (8.5% vs. 0.4%) and had higher data variability than EMS time as the *SD* values were greater than their means at the 12-month pre- and posteducation groups (Table 3). The EDT, by its measurement, is a sensitive but theoretical indicator for assessing early transfer to a verified trauma center. This is because there is an element of waiting time for communication with the trauma center and transport agency before the patient is transferred out. In addition, the time from patient arrival in ED to decision for transfer for definitive care may not be available in some trauma center registries.

For practical purposes, the ED LOS at referring hospitals is a proxy or practical measure for the EDT. The West Virginia study (Kappel et al., 2011) used one-way ANOVA in their statistical analysis with trauma facilities (with and without educational intervention) serving as the independent variable to show EDT reduction. Our study used pre- and postintervention as the independent predictor along with other covariates to demonstrate EDT as well as ED LOS reduction. Using the 6-month data, 31% of the variation ($R^2 = 0.31$, $F = 7.864$, $p = .000$) in the dependent variable (EDT or ED LOS) was explained by the multivariable linear regression model, indicating that more relevant data are required to improve the model. Using the same 6-month data, the distribution of the error term followed the normal distribution by having the mean value close to zero (0.03) and *SD* of 1 (1.016). The normal *P-P* plot of the error term also almost followed the 45° line to meet the normality of the residuals. The heteroscedasticity was not evident by examining the distribution pattern of residuals in the scatterplot. In addition, the variance inflation factor ($VIF > 2$) to measure multicollinearity was not problematic ($VIF \leq 2$). The study demonstrated strong evidence—using either EDT or ED LOS with the multivariable linear regression model—that there was a reduction in the time it took to transfer trauma patients from a community hospital to a verified trauma center after RTTDC education. Most important, this reduction in decision time of transfer could decrease trauma morbidity and mortality.

In measuring the delay or waiting time, there were instances where patient beds were not available at the PTC, or there was time taken for frequent contacts between referring hospitals and receiving trauma centers, as well as between the referring hospitals and transport vehicles for transfer, as shown in the West Virginia study (Kappel et al., 2011).

Limitations

As the geography, demography, distance, and rural ED staffing patterns are different in rural America than urban areas (ACS-COT, 2014; Hsia & Shen, 2011; Whitney et al., 2010), our findings may not be generalizable to other

situations. However, McSwain, Rotondo, Meade, and Duchesne (2012) suggested that the RTTDC, as well as other standard training programs and medical care processes, was required to meet the unique needs of the patient and the facilities in the rural environment in the pursuit of a model for rural trauma care.

In our study, we were not able to include more nurses and other health care providers. This was primarily due to the limited number of courses included in the study, combined with small class sizes limited to just 18 providers. For instance, a total of only eight physicians from five of the nine participating rural hospitals in this study were able to attend the RTTDC education. Of these, five physicians came from three of the four PCHs for the early transfer study. Training with fewer physicians could affect the patient arrival to decision to transfer or EDT if some of the patients were cared for by physicians that did not attend the course. As ABEM-certified emergency physicians or surgeons are seldom employed at rural community hospitals (Stafford et al., 2010), RTTDC education should include all physicians and physician extenders of each rural community hospital for better provider coverage to improve acute trauma emergency care.

Future Research

Similar investigations should be repeated at rural hospitals in different settings, in areas where severely injured patients are transferred to trauma centers and where there is better participation of rural ED physicians. In addition, more relevant covariates, such as individual trauma-related education background, diagnostic tests and procedures undertaken before decision to transfer, and other variables of interest should be included into the model for better model fit. Rural trauma care is included on the research prioritization lists at the Patient-Centered Outcomes Research Institute (2013). Improvement in preventable morbidity and mortality that may result from reduction in EDT or ED LOS should be investigated.

CONCLUSIONS

We believe that this is the first study to demonstrate effectiveness of the RTTDC through perception surveys, and knowledge improvement for rural ED health care staff. The RTTDC third edition evaluation questionnaire is a highly reliable instrument for program evaluation. Our educational intervention study shows evidence of reduction not only in EDT, but also in ED LOS at referring hospitals, both within 6 and 12 months after education.

Finally, this study may provide convincing evidence for the verified or designated trauma centers and scientific communities that the RTTDC is an effective education program for improvement of essential knowledge, practice, and skills for rural ED staff.

KEY POINTS

- The RTTDC is perceived as valuable and educational by rural health care providers.
- Knowledge improvement in nurses and other health care providers through the course could speed up the decision to transfer severely injured patients to a high level of trauma care.
- Reduction in decision time of transfer from rural community hospitals to a verified trauma center could decrease trauma morbidity and mortality.

Acknowledgment

The authors thank Richard Sidwell, MD, FACS, Chair of the Rural Trauma Committee of the American College of Surgeons Committee on Trauma, for his strong support for this research and Thomas Dykstra, MD, for participation as an RTTDC instructor.

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Appendix 1 Outline of the Rural Trauma Team Development Course

Topic	Lecture Content	Team Performance Scenario
Airway	• Definition • Problem recognition: primary survey • Indications for intubation: absolute indications, relative indications • Airway obstruction: internal compromise, external compromise • Assessment: look, listen, feel • Resuscitative procedures: basic and advanced • What are the pitfalls?	• Preparation for emergency airway situations • Presentation of an airway scenario
Breathing	• Definition • Problem recognition • Assessment: look, listen, feel; assessment with resuscitative procedures • Breathing life-threatening injuries: tension pneumothorax, flail chest, massive hemothorax, open pneumothorax, including resuscitation • Chest secondary survey • What are the pitfalls? • What are the adjuncts?	• Preparation for emergency breathing situations • Presentation of a breathing scenario
Circulation	• Definition • Problem recognition • Causes of shock • Assessment • Sites of blood loss and control of blood loss • Responses to initial fluid resuscitation • Damage control resuscitation and successful resuscitation	• Preparation for emergency circulation situations • Presentation of a circulation scenario
Disability	• Definition • Problem recognition: head trauma and assessment, spine and spinal cord injury and assessment • Resuscitative procedures • Avoiding potential pitfalls	• Preparation for any disability situations • Presentation of a disability scenario
Exposure and environmental control	• Definition • Problem recognition • Assessment • Resuscitative procedures • What are the pitfalls?	• Preparation for environmental/exposure situations • Presentation of an exposure and environment scenario
Transfer to definitive care	• Problem recognition • Assessment before transfer • Transfer criteria	• Presentation of a transfer to definitive care scenario
Secondary survey	• What is it? • Its purpose	

(*continues*)

Appendix 1 Outline of the Rural Trauma Team Development Course (*Continued*)		
Topic	**Lecture Content**	**Team Performance Scenario**
Trauma in pregnancy	• Significance of trauma in pregnancy • Diagnostic plans • Fetal salvage	
Pediatric trauma	• Anatomic, physiologic, emotional, and other differences from adult • Special considerations in children • Management of pediatric trauma	
Burns	• Management and triage of severely burned patients • Assess ABCDE as usual	
Process improvement and patient safety (PIPS)	• What is it? • Role of a trauma registry in PIPS • Meaning of inputs, process, output, and loop closure • Performance improvement documentation	